Waterways Postgraduate Student Conference **2022**

Tuesday 8 November 2022
University of Canterbury,
Christchurch, New Zealand

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Conference Programme

Time	Presentation	
8:30	Registration	
9:00	Mihi Whakatau – **Liz Brown, Te Amokapua Māori Tuarua, Deputy Assistant Vice-Chancellor Māori**	
9:05	Welcome – **Professor James Brasington, Director, Waterways Centre**	
9:15	Where are the fish? An assessment of īnanga populations across the South Island's lowland lakes	Chris Meijer, PhD Candidate
9:30	Interactions between transience and heterogeneity in alluvial coastal aquifers	Connor Cleary, PhD Candidate
9:45	Can environmental DNA solve the braided river sampling conundrum to better inform management?	Inge Martens, MSc Candidate
10:00	**Lightning Talks**	
	Evaluation of stormwater's contribution of emerging contaminants to urban waterways	Izaura Oliveira Sarmento, MWaterRM Candidate
	Data analysis and modelling for coastal groundwater hazard assessment under sea-level rise	Amandine Bosserelle, PhD Candidate
	Use of isotopic analysis to determine Managed Aquifer Recharge's contribution to increasing groundwater quantity and quality in an alluvial aquifer	Sidinei Teixeira, MWaterRM Candidate
10:25	Introducing two new Waterways Masters qualifications	Shelley MacDonell, Senior Lecturer, Waterways
10.35	**Morning Tea**	
11:00	Saltwater intrusion from the Ōtākaro Avon River into the shallow aquifer in Ōtautahi Christchurch	Irene Setiawan, PhD Candidate
11:15	Braided river food webs and trophic dynamics across a complex landscape	Holly Harris, MSc Candidate
11:30	Groundwater surface water interaction in a coastal lowland stream: Ōtūkaikino Creek, Ōtautahi/Christchurch	James Manning, MWaterRM Candidate

11:45	The combined effects of flood disturbance and introduced trout on population dynamics of native non-migratory galaxiids	Rory Lennox, MSc Candidate
12:00	**Lightning Talks**	
	Cross validation and characterization of rainfall extreme events between rain gauge data and WRF model in North Canterbury	Andrea Pozo Estivariz, PhD Candidate
	Uncertainty in bathymetry estimation	Martin Nguyen, PhD Candidate
	Reconstructing the past: a review of hindcasting methods and their application to groundwater modelling	Tara Forstner, PhD Candidate
12.25	**Lunch – POSTER SESSION 1 pm in Ngaio Marsh Theatre**	
1:30	Characterising drying and the response of freshwater macroinvertebrates	Elysia Harcombe, MSc Candidate
1:45	Internal structure and water routing contrasts between a debris-covered glacier and a rock glacier using multiple geophysical methods in a semiarid glacier complex	Gonzalo Navarro, PhD Candidate
2:00	Distribution and habitat of kākahi (*Echyridella menziessi* -freshwater mussels) in the South Island and implications for reseeding	Channell Thoms, PhD Candidate
2:15	Understanding the sublethal effects of nitrate pollution on Upland bully in Canterbury, New Zealand	Charlie Barker, MSc Candidate
2:30	**Lightning Talks**	
	How can we best realise social resilience through the usage of urban blue-green infrastructure?	Tyler McNabb, PhD Candidate
	Spatial Patterns of Fine Sediment in the Rangitata River	Justin Rogers, PhD Candidate
	Hydraulic analysis of stormwater management systems: Three case studies from Christchurch	Ruby Evans and Jake Hodder BE Hons Candidates

	Futility or utility? A restoration case study in a rural high country stream system.	Karina Kelly, MWaterRM Candidate
3:00	**Afternoon Tea**	
3:30	Active-distributed temperature sensing to assess groundwater velocity beneath a braided river	Alice Sai Louie, PhD Candidate
3:45	How can multicultural communities be engaged effectively in the process of setting long-term visions for freshwater? A case study of the ethnic Chinese community, Ōtautahi, Christchurch	Chu Zhao, MWaterRM Candidate
4:00	Metals removal efficiency of a downpipe roof runoff treatment system	Jessika Carvalho, PhD Candidate
4:15	Whitebait fishery-induced shifts in kōkopu population dynamics	Ben Crichton, PhD Candidate
4:30	**Drinks and Nibbles; Prize Presentation**	

Posters

Poster Title	Presenter
Data analysis and modelling for coastal groundwater hazard assessment under sea-level rise	Amandine Bosserelle, PhD Candidate
Cross validation and characterization of rainfall extreme events between rain gauge data and WRF model in North Canterbury	Andrea Pozo Estivarez, PhD Candidate
Reconstructing the past: a review of hindcasting methods and their application to groundwater modelling	Tara Forstner, PhD Candidate
Uncertainty in bathymetry estimation	Martin Nguyen, PhD Candidate
Evaluation of stormwater's contribution of emerging contaminants to urban waterways	Izaura Oliveira Sarmento, MWaterRM Candidate
Hydrological drivers influencing nitrate-nitrogen concentration in an alluvial aquifer	Sidinei Teixeira, MWaterRM Candidate

How to find presenters

Presenters, committee members and staff can be identified by coloured name tags. Presenters are keen to hear your questions and feedback, so please feel free to approach them throughout the day. Also, please let a committee member know if you need any assistance.

Posters

There is a scheduled poster session in the foyer from 1:00 to 1:30 pm when all poster presenters will be available at their poster for questions and discussion. However, please feel free to approach poster presenters throughout the rest of the day.

The People's Choice Awards

Please let us know who you think the top three presenters have been so they can be recognised for their presentations. They can be full length, lightning or poster presentations. At the end of the day, fill in the slip of paper at the back of the book and drop it in the box at the front desk. The winners will be announced during the prize presentation.

Welcome

Professor James Brasington
Director, Waterways Centre

Welcome to this, our 12th Waterways Postgraduate Conference! We have an exciting day ahead showcasing the new and emerging research undertaken by our postgraduate students. The success of these conferences really rests on your support. Today we have over 130 external delegates from more than 30 organizations attending, encompassing all parts of the freshwater sector, from industry, government, and community organizations. Bringing this community together provides our students with a vital opportunity to hone their presentation skills, gain feedback and network with key stakeholders and interested parties.

As you will see from the programme, we've changed the format a little this year, introducing a new series of 'lightning talks' at the end of each session. These short-format talks, just five minutes long, are designed to highlight the key findings from students, some of who are also presenting their research as posters at lunchtime. I would encourage you to use these as a catalyst for discussions with the presenters during that break. Today's presentations span the full spectrum of research, from physical hydrology and engineering to freshwater ecology and hydro social perspectives on water, drawing from a diverse array of Departments and Schools across both the University of Canterbury and Lincoln University. Hopefully, there's something here for everyone, and lots of new ideas for us all!

Those who attended last year may recall that I highlighted our plans in the Centre to revitalize our postgraduate courses. We received lots of crucial feedback on those preliminary ideas, and through early 2022, worked up that thinking into a full proposal that went to the national university committee on new academic programmes in July earlier this year. I am absolutely thrilled to be able to announce that our proposal was successful, and we are planning to enrol our first cohort in Water Science and Management in February 2023! A big thanks to all who helped guide our thinking and supported this ambitious proposal.

Finally, I would like to finish by taking the time to recognize all those who have made today possible. As many of you will know, the students don't just make up the presenters, but they are also the organizers of the whole event, supported by the tireless Suellen Knopick. So, a warm thank you to you all for making this happen.

I would also like to acknowledge the generous support of our sponsors, from whom we have received over $5,000 to make today possible. I know I speak for all when I say that your support and encouragement is vital. Tēna koutou katoa,

Ngā mihi nui,

Professor James Brasington

2021 Waterways PG Student Conference presenters

Oral Presentation Abstracts

Where are the fish? An assessment of īnanga populations across the South Island's lowland lakes.

Chris Meijer, PhD Candidate
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Supervisors: David Schiel
Michael Hickford
Duncan Gray

Across the Southern Hemisphere, galaxiid fishes provide many examples of adaptable life-histories, with partial/complete loss of migration occurring repeatedly within diadromous populations. Īnanga (Galaxias maculatus) is a widespread species with a normally migratory life-history, but non-migratory populations have established in lowland lakes of Australia, Chile, and Argentina. Non-migratory fish differ in morphology, reproductive fitness, and timing of life stages.

Īnanga populations in NZ's lowland lakes are poorly understood. We selected 14 lowland lakes/lagoons from the NZ Freshwater Fish Database and surveyed their tributaries for populations of lake-associated īnanga. As a proxy for relative fitness, we compared the length-to-weight relationships of lake-associated īnanga with ten migratory populations. Īnanga were found in tributaries of 4 of the 14 lakes and, despite the lack of larger īnanga, lake-associated īnanga were typically heavier than migratory īnanga at a given length, suggesting greater relative fitness. However, Te Waihora – Lake Ellesmere, previously considered to have robust īnanga populations, was an exception, with no small īnanga present and the remainder in poor condition; this lake is unlikely to support maturing īnanga.

We conclude that īnanga persistence in NZ's lowland lakes is inhibited by a combination of predation, recruitment failure, and lack of food and habitat resources.

Research / Career Interests

- Conservation, freshwater fish, trophic interactions, life histories, migration

Interactions between transience and heterogeneity in alluvial coastal aquifers.

Connor Cleary, PhD candidate
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Supervisors: David Dempsey
Leanne Morgan

Rising sea levels and growing populations put coastal groundwater under increasing pressure worldwide. One challenge for groundwater management is the unobserved nature of groundwater flow and solute transport processes in aquifers. This is especially true in heterogeneous environments where geological variations influence hydrologic processes in a range of environments. Alluvial deposits form important aquifers in New Zealand and worldwide. These deposits can be characterized by small highly conductive channels embedded in a less permeable matrix.

We hypothesize that this aquifer structure causes notable departures in the behaviour of alluvial coastal aquifers from the idealized homogeneous case. To test the nature and scale of these effects, we have used numerical modelling. First, we developed an ensemble of 3D synthetic alluvial aquifer models. Then, we simulated salinity distributions and the position of the freshwater-seawater interface using SEAWAT. Using 3D models allows us to capture alongshore mixing and flow paths not captured by cross sectional models. We analysed how the interface responded during initial aquifer salinization, equilibration, and then after an increase in the offshore head, approximating future sea level rise. This allowed us to assess how heterogeneity affects the size and shape of the mixing zone between fresh and saltwater, and how quickly it responds to external forcings.

These results will form the basis of further work modelling the behaviour of alluvial coastal aquifers under pumping and managed aquifer recharge. Furthermore, the influence of heterogeneity on the characteristics and behaviour of offshore freshened groundwater systems likely to exist in alluvial deposits around New Zealand will be explored.

Research / Career Interests

- Research, industry

Can environmental DNA solve the braided river sampling conundrum to better inform management?

Inge Martens, MSc Candidate
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Supervisors: Amy Osborne
Angus McIntosh

Habitat heterogeneity is thought to be associated with biodiversity within ecosystems and across landscapes. However, we lack empirical data to support this assumption, mainly because of sampling challenges; some rivers are inaccessible and their wide and expansive beds, with many different habitats, means it has been impossible to get a physical sample that is representative of all the different terrestrial and aquatic habitats with conventional approaches. To overcome these logistical and technical challenges, here I employ a new molecular sampling technique, environmental DNA (eDNA).

eDNA is an integrative tool that provides novel information on the terrestrial and aquatic diversity present in braided rivers. In contrast to conventional methods, eDNA can capture molecular information that accumulates from many kilometres away from the sample source, integrating data across broad spatial scales.

In this research, we are investigating if eDNA can be used as a biomonitoring tool in braided rivers to assess biodiversity across broader, often inaccessible, landscapes. Additionally, we are evaluating how river heterogeneity, from both natural and human-driven sources, affects biodiversity in braided rivers.

Preliminary data indicates that eDNA has the potential to add valuable biodiversity information at the landscape scale, suggesting that eDNA could be an accurate and useful tool to sample these dynamic ecosystems. These findings mean that we have the potential to provide novel information that could guide decision making about key but vulnerable habitats in braided rivers.

Research / Career Interests

- Rare ecosystems, freshwater management, epigenetics, science communication

Evaluation of stormwater's contribution of emerging contaminants to urban waterways

Izaura Oliveira Sarmento, MWaterRM Candidate

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Supervisors: Frances Charters
Sally Gaw
Simone Larcher
Tom Cochrane

Emerging contaminants (ECs) are continuously introduced to urban streams as a result of the rapid expansion of urban development and the crucial role that chemicals play in maintaining the living standards of contemporary society. Numerous ECs are harmful to aquatic organisms due to their toxicity, persistence in the environment, and potential for bioaccumulation. Stormwater, which is frequently discharged untreated into the environment, has been identified as one of the primary contributors to the concentration of ECs in urban streams. The concentration of ECs in stormwater could be affected by land use and rainfall patterns.

The objective of this study is to determine the relative influence of catchment land use and precipitation (climate) characteristics on the concentrations of emerging contaminants (ECs) that stormwater contributes to urban waterways. The target analytes of interest for this study include antimicrobial compounds, UV filters, plasticizers, and pesticides.

In this study, three different land-use catchments within Christchurch city have been selected. The three catchments are Addington Brook, Hayton Stream, and Bells Creek which represent industrial and commercial, industrial and residential, and residential, respectively. Moreover, samples are collected during baseflow and stormflow.

This information will inform catchment management practices to address potential issues associated with stormwater-contributed ECs.

Research / Career Interests

- Freshwater management, stormwater management, environmental monitoring

Data analysis and modelling for coastal groundwater hazard assessment under sea-level rise.

Amandine Bosserelle, PhD candidate
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Supervisors: Matthew Hughes
Leanne Morgan
Tom Logan

Rising sea levels will lead to groundwater levels also rising, sometimes exposing coastal cities and settlements to new hazards such as groundwater flooding. Additionally, rising groundwater levels can impact infrastructure in coastal cities through cascading effects due to the failure or disruption of key services and network: drainage issues, sanitation, infiltration and flooding.

To protect coastal settlements from these emerging concerns and maintain urban resilience, hazard assessments will need to include shallow groundwater and address complex surface and underground processes caused by sea-level rise. In order for this to be possible, shallow groundwater areas will need to be identified, appropriate monitoring networks established, and groundwater rise estimated.

Additionally, it is critical to understand the spatial distribution of depth to groundwater and of water table variability due to rainfall events, distance to rivers, the ocean and ground conditions, along with anthropogenic drivers. The overall aim of this research is to develop data analysis and modelling approaches to enable prediction of where and how sea-level rise-induced groundwater dynamics will impact subsurface infrastructure, and how best to manage this risk to the built environment.

Research / Career Interests

- Coastal groundwater; Urban hydrogeology; Sea-level rise impacts

Use of isotopic analysis to determine Managed Aquifer Recharge's contribution to increasing groundwater quantity and quality in an alluvial aquifer

Sidinei Teixeira, MWaterRM Candidate
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Supervisors: Peter Almond
Naomi Wells
Matt Dobson
Brett Painter
Justin Legg

Unsustainable use of irrigation water and nutrient leaching are challenging problems in agricultural settings. In the Hekeao/Hinds Catchment, Managed aquifer recharge (MAR) has been operational in the district to mitigate water quality and quantity for the last six years. This research uses major ions chemistry analysis, including isotopes (δ18O-H2O and Deuterium-H2O), to conclude if MAR contributes to groundwater recharge and diffusion of nitrates pollution in wells down gradient to MAR sites.

Monthly groundwater samples are being collected from 30 bores in three distinctive areas in the catchment for five months. Surface water feeding MAR sites will be collected to establish the source signature. Along physical parameters, all samples are analysed for major ions, iron redox couple, total dissolved carbon, and coliforms, as well as NO3 dual isotopes (δ15N-NO3 and δ18O-NO3) to identify the source and transport of nitrates in groundwater.

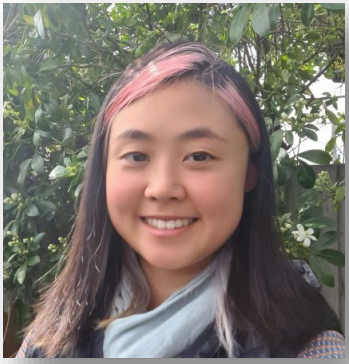
Preliminary results show that all sites in the study area have oxidizing conditions (ORP above 120mV, dissolved oxygen above 6mg/L) and are prone to nitrate-nitrogen accumulation (up to 22mg/L). This could be because the soil profile is composed of alluvial gravels, silt and sand and the absence of organic matter needed for denitrification. Previous data suggests that legacy nitrate-nitrogen is mobilized with each rainfall and leaches to intermediate to deep wells. The next steps include determining what other factors influence nitrate-nitrogen concentration changes in the study area.

This study shows the importance of considering the influence of extreme weather events on groundwater nitrate-nitrogen levels, independent of mitigation measures such as MAR.

Research / Career Interests

- Education, sustainability, water resources

Saltwater intrusion from the Ōtākaro Avon River into the shallow aquifer in Ōtautahi Christchurch



Irene Setiawan, PhD candidate
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Supervisors: Leanne Morgan
Crile Doscher

This research aims to:

• Document a case of saltwater intrusion (SI) from an estuarine river and examine the observed dynamics of groundwater and river levels, horizontal hydraulic gradient, and salinity (proxied by specific conductance).

• Employ signal processing techniques such as cross-correlation and Discrete Fourier Transform (DFT) to analyse the relationship and lag time between the sea, estuarine river, and groundwater.

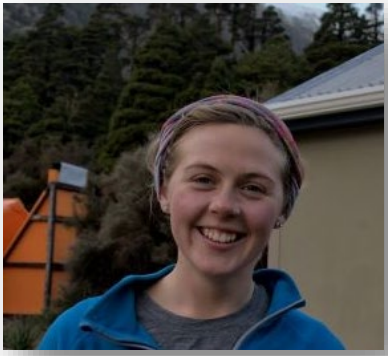
Two transects comprised of five shallow piezometers located perpendicular to the estuarine reach of the Ōtākaro Avon River and one river monitoring site were used. Each monitoring location (groundwater and river) was equipped with a water level, temperature, and electrical conductivity sensor over a five-month period (1 January to 9 June 2021). This study focuses on summer dry periods to characterise groundwater response to tides in the absence of rainfall. Cross-correlation was used to determine time lags between time series data of sea, river, and groundwater heads. Additionally, DFT was used to separate the influence of tidal signals in the time series data.

Freshwater heads and specific conductance in the shallow aquifer at both transects fluctuate with that in the estuarine river. Hydraulic gradient reversals were observed with the ebb and flow of tides in both transects. Cross-correlation and DFT results and interpretations will be discussed in the presentation.

Research / Career Interests

- Coastal hydrogeology, Saltwater intrusion, Political ecology of groundwater issues

Braided river food webs and trophic dynamics across a complex landscape



Holly Harris, MSc candidate
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Supervisors: Angus McIntosh
Jonathan Tonkin
Tara Murray

Riverine systems such as braided rivers often have spatially separate habitats which are connected by predators like birds and fish. These connections by mobile predators may alter food-webs and integrate resources from a wider, more complex, landscape. Moreover, this spatial integration by creating variation in resource pathways could potentially dampen interactions that would otherwise destabilise populations.

We expect major channels of a braided river to have food webs with low resource breadth and smaller niche space than food webs in the surrounding lateral channels, due to disturbance limited productivity, and that these food webs will form a meta-food web where the total niche space and resource breadth is larger.

To test this, we applied stable isotope analysis to a braided river system to investigate changes in food-web structure across a lateral braidplain, and how these food webs may be integrated by mobile consumers. Our results suggest that individual habitats have a smaller isotopic niche space than aggregated habitats and mobile consumers can integrate these food webs, allowing opportunities for a more stable meta-food web through spatially varying resources and interaction strengths across the braidplain.

This spatial variation and connectivity could be critical in braided rivers, which are significantly threatened natural ecosystems where bed shifts and flooding occur frequently, and habitats can be affected at different rates by flooding disturbance or removed completely by terrestrial plant invasions.

Research / Career Interests

- Conservation, systems ecology, freshwater biology, connected environments

Groundwater surface water interaction in a coastal lowland stream: Ōtūkaikino Creek, Ōtautahi/Christchurch

James Manning, MWaterRM candidate
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Supervisors: Travis Horton
Shelley MacDonell
Philippa Aitchison-Earl

The Christchurch-West Melton Water Zone Committee have received reports that the Ōtūkaikino springs could be losing flow. This is of potential concern as this waterbody is considered a 'jewel' of Christchurch, as it has managed to retain many of its ecosystem values. However, there is currently limited understanding of how that hydrological system operates, particularly how it responds to fluctuations in local rainfall and nearby Waimakariri river flow.

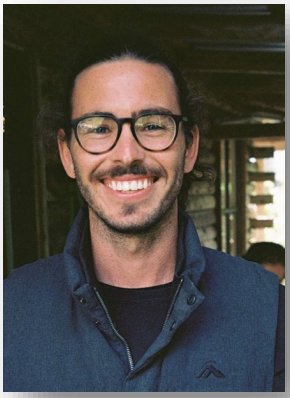
This study aims to address that gap by analysing meteoric, surface and groundwater fluxes around the Ōtūkaikino catchment. Over a period of 4 months, groundwater and surface water levels at two springs were monitored at a 15-minute interval. Over the same period, a set of high temporal resolution water samples (bi-weekly to daily; n=96) were collected throughout the Ōtūkaikino catchment. These sets of data were also compared to longer term groundwater depth data, collected at the nearby Crossbank monitoring array and long-term Environment Canterbury monitoring wells.

The analysis showed that there is a high variability in hydrochemical tracers in precipitation which can be related to the direction and source of weather events. This means that different rainfall origins can be fingerprinted within the Ōtūkaikino catchment. Additionally, there are notable hydrochemical differences between river and groundwater sources, which enable source waters and their interactions to be identified and tracked throughout the catchment. Chemical and physical data suggest the system is remarkably dynamic, with hourly-scale hydrological and hydrochemical responses to significant events. This study also highlights the importance of high-resolution data for recording spring dynamics

Research / Career Interests

- Spring fed streams

The combined effects of flood disturbance and introduced trout on population dynamics of native non-migratory galaxiids



Rory Lennox, MSc Candidate
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Supervisors: Jonathan Tonkin
Angus McIntosh
Nixie Boddy

Flood disturbance and introduced species can interact to influence population dynamics of native freshwater fish. In New Zealand, non-migratory galaxiids face pressure from introduced trout through interspecific competition and predation, as well as increased flood conditions predicted by climate change.

Following an extreme flood event in May 2021, we conducted a field survey across 12 sites in the Canterbury high country. Using mark-recapture techniques to monitor galaxiid growth rates across three flood disturbance and trout density treatments, we investigated how populations of non-migratory galaxiids have recovered from the major flood disturbance and the role of trout in mediating those dynamics.

Initial results suggest that native galaxiid populations displayed higher growth rates in sites with a low trout abundance, compared to sites with high trout abundance and trout-free sites. Additionally, we found an increase in galaxiid growth rate with increasing flood event disturbance. These results suggest that in low numbers, trout may indirectly promote individual growth of native galaxiids by reducing intraspecific competition among galaxiids, and this may be mediated by flood magnitude.

In summary, our results highlight that non-migratory galaxiid population dynamics result from a complex interplay between flood disturbance regimes and introduced trout densities, which presents a challenge for conservation of these species under climate change.

Research / Career Interests

- Freshwater fish, predator-prey interactions, non-native species, conservation, flood disturbances.

Cross validation and characterization of rainfall extreme events between rain gauge data and WRF model in North Canterbury

Andrea Pozo Estivarez, PhD Candidate
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Supervisors: Matthew Wilson
Emily Lane
Marwan Katurji
Fernando Méndez

A cross-validation of rainfall extreme events statistics between rain gauge data and a WRF (Weather Research and Forecasting) model rainfall dataset in the North Canterbury area is carried out for the period 2012-2022 at hourly temporal resolution. To this end IDF curves for each rain gauge location and the corresponding nearest WRF pixel are obtained and different error metrics such as RMSE are calculated. It is found that the extreme rainfall events are reasonably well represented by the WRF model, observing higher errors in locations with more complex topography and in longer storm durations.

Afterwards, extreme rainfall events are characterized temporally and spatially in a more specific area of interest, the Banks Peninsula. To this end an extreme rainfall events population is built based on the WRF dataset. Then the spatial and temporal variability across different duration ranges is explored through the calculation of different variables such as the total storm volume, the development of variograms and the association of these events to their synoptic conditions.

High variability across the spatial and temporal patterns can be found. For instance, within shorter duration storms, greater differences in the total rainfall volume accumulated amongst the pixels can be generally observed or the associated storm shape along time has one clear peak, whereas longer storms are characterized by homogenous and smooth spatial patterns and irregular storm shapes with multiple peaks.

Research / Career Interests

- Flood modelling, machine learning, extreme events statistics, climate change

Uncertainty in bathymetry estimation

Martin Nguyen, PhD Candidate
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Supervisors: Matthew Wilson
Emily Lane
James Brasington

River bathymetry plays a crucial role in flood modelling in the form of DEMs. It increases the reliability, accuracy and continuity of the DEMs. However, river bathymetry is not always available in data-scarce areas because of the time-intensive, laborious and expensive data collection process. This leads to the development of numerous conceptual models and interpolation algorithms for approximating river bathymetry. However, due to limitations in acquiring real-world data and in algorithms, these estimations can introduce implicit uncertainties which can propagate to the model results. These uncertainties will have a direct impact on the amount of flow discharge along the river, which in turn will impact the level of flood depths in the floodplain.

This research investigated the variation in the outputs of a flood model, where multiple DEMs were generated from LiDAR and estimated bathymetric data, and each was used to predict flood inundation. In that, the values of the channel width, the topographic slope, the flow discharge, the friction coefficient, and the exponents used to estimate the bathymetry data for the Waikanae River area, New Zealand were varied to produce multiple DEMs. These DEMs containing different riverbed elevation information were then used in the hydraulic model LISFLOOD-FP to generate the flood maps. The variability in the results was then analysed statistically, allowing the sensitivity of model predictions to the aforementioned parameters to be assessed.

Research / Career Interests

- Spatial) data science, deep learning/machine learning/AI, hydrology, GIS, computer science

Reconstructing the past: a review of hindcasting methods and their application to groundwater modelling

Tara Forstner, PhD candidate
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Supervisors: Leanne Morgan
Catherine Moore

Our understanding of hydrological conditions exists mainly within the era of modern measurement, with most groundwater data generally recorded within the last 50 years. The current trajectories of groundwater system degradation (i.e.. groundwater depletion) have been limited to relatively recent trends (<100 years). Many of these depletion calculations assume baseline conditions near the advent of groundwater monitoring periods, however, this adds an inextricable bias to these trends which excludes early European settlement land modifications (i.e.. irrigation drains, river diversions) which may have had permanent effects on the hydrological regime. Global restoration initiatives, such as the UN Decade on Ecosystem Restoration (see https://www.decadeonrestoration.org), which aim to "halt, prevent, and reverse ecosystem degradation" globally, raises questions about how to determine baseline conditions to which restoration targets are set. Understanding the state of the environment prior to the era of modern measurement is critical in achieving collaborative environmental outcomes through the perspective of marginalized groups who may have unique relationships with the environment.

Although principles for specific restorative activities have been explored for many terrestrial and marine systems, there are few studies which have explored the freshwater perspective and even fewer which explicitly consider the role of groundwater. Our research aims to review previous methods and applications of hindcasting – the method of modelling past conditions, and discuss the unique challenges and opportunities of hindcasting for future research and implications for water management targets.

Research / Career Interests

- Groundwater, mumerical modelling, hindcasting, anthropogenic impacts, indigenous knowledge, restoration

Characterising drying and the response of freshwater macro-invertebrates

Elysia Harcombe, MSc Candidate
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Supervisors: Helen Warburton
Angus McIntosh

Droughts are forecast to become more frequent and intense due to a combination of climatic change and water resource over-allocation. This has major implications for freshwater organisms as their habitat size shrinks and abiotic stress intensifies, thereby increasing the intensity of biotic interactions. Additionally, understanding processes that structure drying communities is important for predicting the effects of climatic change and managing freshwater resource use. However, little is known about the mechanisms that shape drying streams and how biota respond.

We aimed to untangle the role of some these mechanisms, focusing on freshwater macroinvertebrates. The key drivers we investigated included abiotic stress, the organisms already present in the stream and its' history, macroinvertebrate drift and life history trade-offs. We analysed data from space-for-time surveys of drying streams in Arthur's Pass, sampling several sites along a gradient of drying. At each site, data was collected on the stream's abiotic conditions, macroinvertebrate communities and macroinvertebrate drift.

We show that abiotic stress from multiple variables increases with drying and is associated with changes in the macroinvertebrate communities present. Additionally, invertebrate drift and their life histories change as drying intensifies. This suggests the mechanisms driving invertebrate responses to drying may include a mix of deterministic factors, such as abiotic stress and species' interactions, as well as mass effects and patch dynamics from macroinvertebrate drift and life history trade-offs.

Research / Career Interests

- Freshwater, invertebrates, conservation, restoration, ecology

Internal structure and water routing contrasts between a debris-covered glacier and a rock glacier using multiple geophysical methods in a semiarid glacier complex

Gonzalo Navarro, PhD Candidate
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Supervisors: Shelley MacDonell
Rémi Valois

Rock glaciers are the most abundant glacial landform in the Semiarid Andes (SA, 27-34°S), covering about three times the area of mountain glaciers. Recent studies suggest they possibly play an important hydrological role, including producing, routing and storing water. However, the details of this role are still contentious. These processes are also particularly complicated in glacier complexes (i.e. where there is a juxtaposition of glacial types and landforms), which are common in semiarid areas like the Dry Andes or Himalayas.

This study aims to determine internal structure and potential hydrological routing pathways of different glacial landforms, using a series of geophysical surveys in the Tapado glacier complex, Chilean SA (30°S, >4200 m asl). The results suggest that while the debris-covered glacier shows probable hydrological routing zones exclusively in the area above the buried massive ice, the rock glacier would have more hydrological transfer routes downstream due to its fragmented ice structure, with vertical passages that could conduct supra-permafrost water to sub-permafrost sectors, where baseflow can route water to downstream through sub-horizontal pathways beneath the main permafrost body.

This work contributes to a better understanding of the hydrology of headwaters catchments in dry environments, where runoff is originated and where complex interactions between diverse landforms occur.

Research / Career Interests

- Mountain hydrology; permafrost; hydrogeochemistry; hydrogeophyisics; glacier and snow dynamics

Distribution and habitat of kākahi (*Echyridella menziessi* -freshwater mussels) in the South Island and implications for reseeding

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John Pirker
Catherine Febria

Kākahi (*Echyridella menziesii* – freshwater mussels) are a taonga (highly valued) species found in lakes and waterways throughout Aotearoa New Zealand. They are highly regarded by some iwi as a mahinga kai resource. Distribution and habitat preferences of kākahi are not fully understood and there are large knowledge gaps around current distribution of kākahi, particularly in streams.

To address these knowledge gaps, we investigated the distribution and habitats of kākahi in lotic environs within the Ngāi Tahu /Kāi Tahu takiwā of the South Island. We compared historical distributions and the findings from our survey to ara tawhito (traditional travel routes). Te ara tawhito were widely used by Ngāi Tahu /Kāi Tahu, hapū and whānau for mahinga kai (resource gathering), kaihaukai (trade), to access nohoanga (temporary camp sites) and whanaungatanga (relationship building).

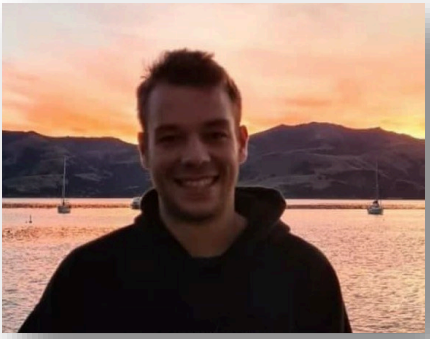
From fieldwork surveys, we found that distributions were patchy and that kākahi can occur in various benthos types including silt, sand, gravel, cobbles and among macrophytes. Although it appears kākahi can persist in a range of environments, we were interested to see if, given a choice, they might show preference for certain substrate and if they can adapt to new habitat types.

Habitat choice and translocation experiments indicate that kākahi do not appear to have a preferred substrate type. This suggests that substrate type may not be a barrier for future reseeding and translocations.

Research / Career Interests

- Working alongside rūnanga and communities incorporating Mātauranga, restoration ecology, applied science

Understanding the sublethal effects of nitrate pollution on upland bully in Canterbury, New Zealand



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Jon Harding
Daniel Gomez Isaza

Nitrate pollution is a pervasive threat affecting many freshwater ecosystems in New Zealand. In particular, intensive agricultural activities in Canterbury have resulted in high levels of nitrate pollution reaching freshwater streams and rivers. Freshwater fish are especially vulnerable to nitrate pollution because nitrate continuously seeps into their bodies through their gills and reduces their ability to carry oxygen in their blood. The National Policy Statement for Freshwater Management (NPSFM) recently established a national bottom line of 2.4 mg NO3- – N/L of nitrate-nitrogen allowed in rivers, as a protective measure. However, these limits are primarily based on lethal toxicity tests, which overlook potential sub-lethal effects that can occur at much lower concentrations.

To test the validity of the national bottom line, we investigated the sub-lethal effects of nitrate pollution on the upland bully *(Gobiomorphus breviceps*), an endemic freshwater fish. By combining lab and field-based studies, we show how nitrate pollution affects growth, energy-stores, metabolism and tolerance to heatwaves. The results of this study will better inform policy and regulation concerning nitrate pollution and thus aid in the conservation of our freshwater fish species and the health of our waterways.

Research / Career Interests

- Anthropogenic impacts on New Zealand's aquatic species, sustainable aquaculture

Hydraulic analysis of stormwater management systems: three case studies from Christchurch

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This project analyses the hydraulic performance of three stormwater management systems in Christchurch: Number One Drain, Wigram and Cox's Quaife's stormwater treatment facilities. These systems include components such as a wetland, floating treatment wetland and first flush detention basin, and therefore represent a variety of system types found in Christchurch. Analysis was based on existing and new field data using water level loggers to understand the relationships between water levels, rainfall data and the hydraulic response of each system.

Our research aimed to:

- Identify key characteristics of each systems' hydraulic response such as level change, lag time and hydraulic retention time to a range of storm events.
- Compare post-construction hydraulic performance with design.
- Identify key factors that influence hydraulic performance.

This analysis will support Christchurch City Council to optimise their management and monitoring of these systems, informing the use of low-cost water level sensors to better understand Christchurch's stormwater basins performance.

Research / Career Interests

- Stormwater engineering, environmental engineering

How can we best realise social resilience through the usage of urban blue-green infrastructure?

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Edward Challies
Rita Dionisio

With the impacts of climate change and COVID-19 being felt worldwide, there has been a recent focus on the ways in which social resilience can be enhanced. It has been hypothesised by multiple scholars that there is a need for a paradigm shift in urban design towards multi-functional urban blue-green infrastructure (BGI), as the business-as-usual is likely to exacerbate the risks, vulnerabilities, and inequalities associated with these hazards.

However, this shift is yet to fully take place, while BGI that has been implemented may not be optimised. This is due to key research gaps surrounding the existing lack of knowledge of the wider socio-ecological co-benefits of urban BGI amongst city-making actors, as these can span numerous scientific fields. There are several key challenges that need to be addressed in order to optimise the usage of BGI and subsequently enhance social resilience.

As such, this research seeks to identify the key bio-physical and socio-cultural benefits of urban BGI and highlight the ways in which these may contribute to enhanced social resilience.

Research / Career Interests

- Social resilience, blue-green infrastructure, multi-solutions

Spatial patterns of fine sediment in the Rangitata River

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Jo Hoyle
Jonathan Tonkin

The presence of excess surficial and interstitial fine sediment in gravel- and cobble-bed rivers may create a cascade of impacts that degrade ecosystem health, recreational value and natural character.

A detailed dense lidar and orthophotography map of the Rangitata River has found longitudinal patterns in surficial fine sediment, surface roughness and vegetation distribution. Three annual river elevation change maps show areas of change and stability and allow surface facies to be related to recent river history.

Preliminary hydraulic modelling relating river flows to sediment mobilization shows how areas regularly inundated differ in fine sediment distribution from those rarely inundated or protected from strong currents.

Research / Career Interests

- Rivers, lakes, estuaries and oceans; big data and numerical modelling

Futility or utility? A restoration case study in a rural high country stream system

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James Brasington

Anthropogenic impacts on waterways and their catchments have led to a global trend of degradation in freshwater ecosystems. Sustainable management options to alleviate these pressures have become increasingly important alongside the development of appropriate restoration measures to remediate degraded rivers. To date, restoration projects have met varying levels of success, but often fail to demonstrate improvements in biological metrics of ecosystem health. Restoration ecology as applied to freshwater systems is a rapidly advancing field, yet restorative interventions are rarely informed by ecological theory or framed at the ecosystem level. This approach, in conjunction with regulatory hurdles, has contributed to inappropriate restoration techniques being implemented in catchments. Consequently, this results in a waste of resources and time for regulatory bodies and landowners and inadvertently allows degradation to continue despite good intentions.

To address these issues in-situ, ecological and water quality/quantity data will be collected from an agriculturally impacted stream, where land use changes and restoration efforts have been undertaken. Policy barriers that the stakeholders involved in restoration have faced will be examined by qualitative surveys. Broadly, the data collected will be used to characterise variations in freshwater biodiversity along a degradation gradient and quantify the causes.

This will aid in assessing the efficacy of the restoration measures, in relation to land use and catchment processes affecting the stream and provide a guide for further restoration and research.

Research / Career Interests

- River restoration, conservation ecology, policy

Active-distributed temperature sensing to assess groundwater velocity beneath a braided river

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David Dempsey
Eddie Banks
Scott Wilson

River leakage from braided rivers is a significant source of groundwater recharge in the Canterbury Plains of New Zealand. This study investigated surface water – groundwater (SW – GW) interaction beneath the Waikirikiri Selwyn River, in the South Island of New Zealand, using Active-Distributed Temperature Surveys (A-DTS) and estimated surface water loss (groundwater recharge) to the alluvial aquifer systems under various flow regimes.

The field study site is an active river channel, approximately 70 m wide comprising one to three braids and is within a 35-km long ephemeral losing reach of the river. Horizontal Directional Drilling (HDD) was used to construct two, 100 m long drillholes at a depth of 5 m beneath and perpendicular to the river channel. Additionally, two vertical A-DTS installations were constructed to 30.4m depth. The drillholes were completed with a hybrid fibre optic cable containing four multi-mode fibres and copper conductors.

Monthly A-DTS surveys show distinguishable seasonal variations in temperature of the shallow braid plain aquifer. The localised temperature variations along the cable indicate spatial variation of preferential groundwater recharge pathways. Ongoing work is being done to quantify the river leakage loss using a modified version of the heat-flow transport equation to derive groundwater velocities, providing valuable insight into how groundwater recharge varies temporally beneath braided rivers. Preliminary results indicate groundwater velocities exceeding 10 m/d.

Research / Career Interests

- Surface water–groundwater interactions, active distributed temperature sensing, braided rivers

How can multicultural communities be engaged effectively in the process of setting long-term visions for freshwater? A case study of the ethnic Chinese community, Ōtautahi, Christchurch

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Supervisors: Steve Urlich
Sarah Edwards

The National Policy Statement for Freshwater Management (NPS-FM) introduced Te Mana o te Wai (loosely translated as the vital importance of water) and requires councils to engage with communities and tāngata whenua (Clauses 3.2, 3.3 & 3.4). It is important for local authorities such as Environment Canterbury (ECan) to engage with a diversity of cultures. According to Stats NZ 2018, people of Asian ethnicity make up about 15% of the population, and the ethnic Chinese is the largest proportion within that population category.

Previous research (e.g. Wang, 2019) indicates that ethnic Chinese in Christchurch are willing to be involved in environmental planning, but there are barriers to their participation, such as lack of local environmental and political knowledge.

This study aims to explore the meaning of Te Mana o te Wai to ethnic Chinese living in Christchurch, and to identify and evaluate effective ways of engaging with ethnic Chinese in developing long-term visions for freshwater management. The data was collected during July and August 2022. An anonymous survey of 151 local Chinese community members was conducted: 67 responses were collected in person and 84 responses collected online through social media channels. Ten semi-structured interviews were also conducted: five with central and local government representatives, and five with local Chinese community leaders. The main results for both surveys and interviews will be presented and discussed.

Research / Career Interests

- Freshwater management, engagement and communication, multicultural environmental management

Metals removal efficiency of a downpipe roof runoff treatment system

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Aisling O'Sullivan

Impervious surfaces such as roads and carparks, but especially metal roofs, are important sources of heavy metals, which are considered pollutants of concern for urban streams. Zinc and copper are prevalent in roof runoff in Aotearoa New Zealand as they originate from the dissolution of galvanized steel and copper sheet roofing widely used in the country. Most of these metals are found in a dissolved form, which is difficult to remove with conventional treatment systems that are primarily aimed at removing particulates.

A retrofittable downpipe treatment system containing waste seashells, namely the Storminator™, was developed to remove metals from roof runoff prior to it reaching the stormwater network. This on-going study conducted in Ōtautahi Christchurch investigates the efficiency of the Storminator's™ cartridge media in treating runoff from four different metal roof types over different seasons. The aim is to better understand how the metal roof type, and climate and storm characteristics, influence the Storminator's™ treatment efficacy.

Preliminary results show the Storminator's™ good performance at removing metals from all roof types (i.e., up to 90% removal efficiency). Metal roof types and climate characteristics can influence the roof runoff characteristics and, consequently, the treatment efficiency of the Storminator™.

Research / Career Interests

- Roof runoff, dissolved metals, Downpipe Treatment System (DTS), stormwater treatment

Whitebait fishery-induced shifts in kōkopu population dynamics

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Supervisors: Mike Hickford
Angus McIntosh
Dave Shiel

Understanding the effects of the whitebait fishery on harvested species is vital to ensure a sustainable fishery that does not threaten the conservation of component species. We tested whether whitebaiting, the harvesting of post-larval migratory fish, influenced population dynamics of endemic banded kōkopu (*Galaxias fasciatus*), giant kōkopu (*G. argenteus*), and shortjaw kōkopu (*G. postvectis).* Using spotlighting, we sampled kōkopu populations bimonthly for two years across five fished and three unfished rivers on the West Coast. We measured fish lengths and weights and used capture-mark-recapture techniques to estimate the composite biomass, apparent survival, and relative growth rates of each kōkopu species.

After controlling for the effects of local habitat characteristics, we found that unfished streams had greater biomass of small kōkopu (≤ 90 mm), particularly during whitebait migrations, which was primarily composed of banded kōkopu. Despite the greater influx of post-larvae into unfished areas, there was no difference in the biomass of larger size-classes (>90 mm) between fished and unfished rivers, suggesting that whitebaiting does not cause recruitment limitation for kōkopu populations. However, fishing-induced shifts in density-dependent processes resulted in unfished populations having greater large fish survival and higher growth rates.

Our findings show that whitebaiting influences kōkopu population dynamics by altering small fish densities but poses no threat to kōkopu population sustainability. We discuss the implications of habitat regulated density-dependent processes for the conservation and management of threatened whitebait species.

Research / Career Interests

- Aquatic ecology, conservation biology, fishery sustainability

About Our Platinum & Gold Sponsors

Environment Canterbury is the regional council for this magnificent region. In Canterbury we have one of the most astonishing environments in New Zealand – from the turquoise Lake Tekapo, the stunning Southern Alps, the widespread agricultural plains, and beautiful coastline – not to mention our 'capital' city of Christchurch – and everything in between. The regional council is responsible for this environment, with the community's support and in collaboration with many other organisations.

The work of Environment Canterbury takes place under five broad portfolios:

1. Water and Land;
2. Biodiversity and Biosecurity;
3. Climate Change and Community Resilience;
4. Air Quality, Transport and Urban Development;
5. Regional and Strategic Leadership.

Within these portfolios, the regional council covers such things as the Harbourmaster's Office, regional parks, coastal erosion, buses, pest management, flood protection, and air pollution.

A key part of the way we work is through our Ngāi Tahu Partnership. This is cornerstone to Environment Canterbury as a Tiriti (treaty)-based organisation but also enhances our ability to be an effective natural resource manager. We also work closely with central and other local government agencies, businesses, industry sectors and community and volunteer groups to manage natural resources.

We are proud to support the 2022 Waterways Postgraduate Student Conference. Water is the driving force behind much of our economy and protection of this precious resource requires science to mitigate negative impact to ensure that we have a positive impact.

Selwyn stretches across the Canterbury Plains, bounded by the Rakaia and Waimakariri Rivers, with Arthur's Pass National Park in the Southern Alps to the west and the Pacific Ocean to the east.

With a population of more than 75,000 Selwyn is the third largest territorial authority in the South Island, following years of sustained growth. While this growth was initially driven by relocation following the Canterbury earthquakes, it is now equally sustained by industrial and commercial movement towards the south west of Greater Christchurch. The district also supports a thriving primary production sector including dairying, assisted by ongoing irrigation investment.

Selwyn District Council is planning significant investment over the next 10 years in community services, facilities and infrastructure, including the management of our 5 Waters services – water supply, wastewater, stormwater, land drainage and water races. This is of course dependent on the Three Waters Reform.

The availability of clean, safe water and the safe disposal of wastewater are fundamental to the health of our community and natural environment. The Council takes an integrated approach to managing water resources, recognising that our 'mountains to sea' landscape means there is a strong connection between these services.

Much of the district lies within the catchment of Te Waihora/Lake Ellesmere, one of New Zealand's most important wetland systems, and central to the mana of Ngāi Tahu. The Council is working actively with Ngāi Tahu, Environment Canterbury and other partners on widespread cultural and ecological restoration projects.

Other priority projects include the expansion and upgrading of wastewater treatment facilities, increasing water supply capacity and the upgrade of water supply treatment plants.

Christchurch City Council

Across Christchurch and Banks Peninsula there is a network of waterways and lakes. These range from large lakes to narrow tributaries with intermittent flows, including:

- Lake Forsyth/Te Roto o Wairewa and part of Lake Ellesmere/Te Waihora, as well as a number of smaller lakes
- About 78 kilometres of rivers, including the Avon/Ōtakaro River, Heathcote/Opāwaho River, Styx/Puharakekenui River, and part of the Waimakariri River and Halswell/Huritini River, as well as a number of rivers on Banks Peninsula
- About 2605 kilometres of river tributaries and other smaller streams (many of them ephemeral).

Improving the quality of our waterways is a goal of our community and is a priority for the Council. It's also a requirement of the Council's Comprehensive Stormwater Network Discharge Consent (CRC214226).

Under the consent the Council:

- Monitors water quality at over fifty waterway and coastal sites within Christchurch City and Banks Peninsula monthly.
- Is developing stormwater management plans for river catchments where there are stormwater networks
- Is undertaking feasibility and technical studies to look at improving the performance of stormwater treatment facilities
- Is undertaking flood modelling to determine the level of stormwater volume mitigation required (using stormwater basins), to stop downstream flooding from new developments
- Working with industry to improve stormwater runoff from high-risk activity sites
- Has an advisor supporting the programme of work being carried out by the Community Waterways Partnership
- Has appointed a Mahinga kai / Nga wai Advisor to ensure mana whenua and cultural valves are incorporated across the consent work.

Given the diverse range of work that Council is undertaking there is opportunity for student involvement. In the past there have been a number of summer student scholarships, providing literature reviews and evaluations of potential community behaviour change programmes. These opportunities will continue to be available so keep an eye out for them.

Davis Ogilvie (DO) water specialists work across the groundwater, surface water, hydrology and 3-waters space. Our services span resource consent monitoring, designing treatment and discharge systems for industrial sites, and high-level planning for large catchments to protect and preserve water resources.

Getting this right is essential in an environment of increasing urbanisation and we are involved at every stage, working closely with local authorities and private sector clients. Our team includes planners, surveyors, geotechnical engineers, environmental scientists, civil engineers and structural engineers. Our water capabilities include; water quality monitoring and resource consent compliance, waterway naturalisation, flood management, GoldSIM modelling, dewatering management, design of 3-waters infrastructure, stormwater treatment system design using Sustainable Urban Drainage (SUDs), and hydrogeological modelling and investigations.

Within urban developments, we work to incorporate low impact stormwater treatment systems such as raingardens, tree pits and wetlands. We designed the raingardens at the Waterloo Business Park as an effective and efficient system to treat the large volumes of road runoff– and they look great!

We can do what we do because our team covers the complete range of multi-disciplinary engineering, surveying, and development planning services within one company. We are able to look at each project holistically within its catchment and collaborate with stakeholders to find the best solution.

We are also proud to be part of the Community Waterways Partnership Charter, led by Christchurch City Council. This charter is a shared statement of intent where community groups, researchers, companies, and regional/central government work together to protect and enhance Christchurch's precious urban waterways. Let's all be part of this collaboration.
We applaud and support the Waterways Postgraduate Student Conference.

ENGEO is an award-winning firm of geotechnical engineers, geologists, environmental scientists and asbestos specialists. We are not just another typical engineering and environmental consultancy. Sure, we're professional, reliable, and customer focused, but we're also dynamic, innovative and creative. We truly live out our ethos that letting our people shine is best for our business and our clients. We thrive by finding meaningful opportunities to promote growth and prosperity for our clients, employees and communities.

Our team is focussed on minimising the environmental impact of our clients projects whatever and where ever they may be in New Zealand. From residential subdivisions and brownfield redevelopment sites through to former hospital demolition projects and hazardous materials remediation, we support making decisions that benefit the local environment, societies in which we work and make economic sense to our clients.

We recognise that water both globally and here in Aotearoa is increasingly under more pressure due to land use intensification and greater demand for this invaluable resource.

ENGEO offers a comprehensive range of hydrological services including groundwater supply and management, groundwater impact assessments, regulatory applications and consent management, and stormwater assessment and management.

At ENGEO we want to support all involved in the research and protection of our water and especially encourage those involved in the Waterways Postgraduate Student Conference.

Hill Laboratories is New Zealand's largest 100% privately owned and operated analytical testing laboratory with three major testing areas: agriculture, environmental and food. Tried, tested and trusted for over 30 years, our focus has remained unchanged: providing New Zealanders with the best analytical testing service on offer.

Founded in 1984 by Dr Roger and Anne Hill, the company remains family owned today. As a company we are firmly committed to developing our people through our career advancement framework, and fully support staff in gaining varied technical experiences. With branches located in Hamilton, Tauranga, Auckland, Wellington, Blenheim and Christchurch, Hill Laboratories is a significant employer of science graduates from New Zealand tertiary institutions.

Our Land and Water is one of 11 National Science Challenges that focus on issues of national importance. The Challenges were designed to take a more strategic approach to the Government's science investment by targeting goals that, if achieved, will have major and enduring benefits for New Zealand.

For Our Land and Water, this means tackling the biggest science-based issues and opportunities facing our country in the area of primary production, and the complex relationship it has with our precious land and water resources.

Our mission is to preserve the most fundamental treasures of our country – our whenua, awa and associated ecosystems – while producing value from those same treasures. As a challenge, this is the ultimate. Every New Zealander, both alive today and yet to come, has a stake in the outcome.

The National Science Challenges are transdisciplinary, mission-led programmes that require collaboration between universities, Crown Research Institutes, businesses, iwi and non-government organisations to achieve their objectives.

Our Land and Water is one of the largest National Science Challenges, funded by MBIE for up to $96.9 million over 8 years.

Our Land and Water has now begun its second phase of funding the research to deliver on our mission. To learn about future funding and research opportunities, sign up for our e-newsletter: https://ourlandandwater.nz/news-events/

Water New Zealand is the industry body for the three waters sector – drinking water, wastewater and stormwater.

We advocate and promote the sustainable management of the water environment and in particular, the three waters through supporting members, and engaging with key partners and stakeholders.

We are the "go-to" three waters advisor, providing independent technical advice and data, workforce training, and delivering and enabling knowledge-sharing across New Zealand and internationally.

Our membership is made up of 3000 decisionmakers and technologists from local and central government, industry, the academic and research communities, consultants and service/equipment and supply organisations.

We work closely with members and partners to support Te Mana o te Wai and the Treaty of Waitangi.

'Ka ora te wai, ka ora te whenua, ka ora ngā tāngata'

'If the water is healthy, the land is healthy, the people are healthy'

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